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EXAMINER	
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ART UNIT	**PAPER NUMBER**
2628	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/797,743	KII, YASUYUKI	
	Examiner	Art Unit	
	Jason M. Repko	2628	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on ____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11* is/are pending in the application.

4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5)☐ Claim(s) ____ is/are allowed.

6)☒ Claim(s) *1-11* is/are rejected.

7)☐ Claim(s) ____ is/are objected to.

8)☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *15 January 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date ____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: ____.

DETAILED ACTION

Claim Objections

1. In view of the amendment submitted 4/5/2006, the objections to claims 1, 4, and 9 are withdrawn.

Response to Arguments

2. Applicant's arguments filed 4/5/2006 have been fully considered but they are not persuasive.

3. With regard to Applicant's argument "Kelley does not teach or suggest a shadow polygon conversion section," Kelley processes shadow polygons by "converting the graphic data to visual-point coordinates and depth values" (*lines 45-47 of column 14; lines 18-19 of column 24*), and "outputting the visual-point coordinates and the depth values in a state of being sorted into those of front-facing shadow polygons that face front when seen from a visual point and those of back-facing shadow polygons that face back when seen from the visual point" during shadow processing (*lines 61-64 of column 21; lines 18-19 of column 24*) as referenced in the Office Action dated 1/6/2006.

4. Applicant asserts, "in Kelley, only the graphic data of active objects is converted to coordinates" in the first paragraph of page 9 of the remarks. In support of this assertion, Applicant references statements in lines 5-10 and 37-40 of column 14 and Figure 7, which merely show active objects are converted to coordinates but do not mention the role of shadow polygons. To further support the assertion that Kelley et al discloses converting graphic data of shadow polygons to visual point coordinates, Applicant's attention is directed to the following statements from the Kelley et al reference. Kelley et al discloses the Z set-up tokens are

generated during stage 1 pre-processing (*lines 18-19 of column 24*), and in stage 1 pre-processing the X-coordinate spans and a Y-coordinate are determined for active objects (*lines 34-37 of column 14*) and tokens are computed such that the Z set-up tokens are generated for end-points of the span (*lines 45-47 of column 14*). Kelley et al discloses Z set-up tokens correspond to "shadow polygons" as evidenced by the statement in lines 61-64 of column 21 (*"The shadow polygons can be either front or back facing. Their orientation is specified by a flag, 'front', specified in the Z setup token (described in more detail below)."*). Furthermore, Kelley et al discloses testing the shadow polygons at each pixel using the Z set-up tokens (*lines 54-57 of column 21; lines 2-4 of column 22*). These statements show that the shadow polygon graphic data are converted to a pixel location (e.g., X-coordinate and Y-coordinate) in the process of performing shadow analysis, which is analogous to "converting graphic data on shadow polygons to visual point coordinates" as recited in the claims. The per-pixel visibility and shadowing calculations as disclosed by Kelley et al are made possible by converting the shadow polygon graphic data from three-dimensional space to pixel locations because the set of shadow polygons are defined as bounding a "shadow volume" in three-dimensional space (*lines 43-45 of column 21*).

5. With regard to Applicant's argument "the Higashiyama reference does not teach or suggest a graphics processing apparatus including a 'hidden surface removal and shadowing processing section,'" Higashiyama teaches a shadow image comprising shadow pixels defining a the coordinate region "positioned behind the front-facing shadow polygons and in front of the back facing polygons" in lines 19-23 of column 6 as referenced in the Office Action dated 1/6/2006. Specifically, "pixel positions," "the Z-values," and "Z-value memory" (8b) disclosed

by Higashiyama are analogous to "visual point coordinates," "depth values," and "Z-buffer memory" as recited in claim 1. Higashiyama discloses the shadow pixels correspond to "front-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels" (*lines 22-24 of column 6*). If a front-facing polygon has smaller distance to a view point (*line 24 of column 6*) than that of another primitive at a given pixel location in a region as indicated by the value in Z-memory (*lines 14-17 of column 6*) then the primitive at that point in the region must be "positioned behind the front-facing shadow polygons" with respect to the viewpoint. In other words, when comparing Z-values to values in Z-memory for a given pixel position, the smaller of the two values corresponds to the front positioned primitive with respect to the viewpoint. Higashiyama further discloses that pixels are excluded from the region if the pixels correspond to "the back-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels" (*lines 25-28 of column 6*). Thus, the shadow image comprises a region of pixels that are positioned "behind the front-facing shadow polygons" excluding pixels that are behind back facing polygons. In other words, a region that is "positioned behind the font-facing shadow polygons and in front of the back facing shadow polygons when seen from the visual point" as recited in claim 1. The pixel positions for this region are obtained based on "the Z-values," and "Z-value memory" (8b).

6. In view of the amendment submitted 4/5/2006, the rejection under 35 U.S.C. 101 is withdrawn.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. **Claims 4, 6, 9, 10 and 11 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,517,603 to Kelley et al (herein referred to as "Kelley et al").**

9. With regard to claim 4, Kelley et al discloses "a graphic processing apparatus (*Fig. 4*) having a Z-buffer memory storing a Z value representing a depth of a display object when seen from a visual point per pixel (*lines 39-44 of column 32: "The Z-interpolation and compare module 1204 is coupled to the RAM control 1203 to receive the current Z-value at a pixel location and for inserting a new Z-value into the scanline Z-buffer when appropriate (i.e. the Z-value of the current pixel is less than the current value in the Z-buffer)."; lines 63-66 of column 31: "When performing scanline Z-buffering or operating as a compositing engine, both require at least one complete scanline of memory."; Fig. 12*) and a pixel memory storing color data on each pixel for creating an image (*lines 54-58 of column 32: "With respect to stage 3, the αRGB module 1205 is coupled to RAM control 1203 in order to received pixel shading values at the current pixel location and for inserting shaded (blended) pixel values back into the scanline buffer."; Fig. 12*) of a shadowed three-dimensional object having shadows produced by obstructing a ray of light from a light source by the three-dimensional object (*lines 39-41 of column 21: "The shadowing algorithm utilized in the preferred embodiment provides for the*

determination of object shadow volumes (with respect to a particular light source)."),
comprising:

a. a normal polygon conversion section for upon input of graphic data on normal polygons constituting each object including the three-dimensional object, converting the graphic data to visual-point coordinates and depth values (*lines 37-40 of column 14: "Following the calculation of the span coordinates, corresponding parameter values are then generated for the span end-points, step 803."*; *lines 45-47 of column 14: "Such span parameter set-up tokens contain the RGB values or Z-values for the end-points of the span that were generated in step 803."*);

b. a shadow polygon conversion section for upon input of graphic data on shadow polygons constituting a shadow volume that defines a shadow space produced by obstructing the ray of light from the light source by the three-dimensional object (*lines 39-45 of column 21: "...All objects inside of the volume would thus be in shadow. Sets of dummy polygons, bounding the shadow volume, are calculated by the host processor (or alternatively by control processors as illustrated in FIG. 6a)."*), converting the graphic data to visual-point coordinates and depth values (*lines 45-47 of column 14; lines 18-19 of column 24: "As noted above, set-up tokens are generated during stage 1 pre-processing."*), and outputting the visual-point coordinates and the depth values in a state of being sorted into those of front-facing shadow polygons that face front when seen from a visual point and those of back-facing shadow polygons that face back when seen from the visual point (*lines 61-64 of column 21: "The shadow polygons can be either front or back facing. Their orientation is specified by a flag, "front", specified in the Z setup token*

(described in more detail below)."; *lines 18-19 of column 24: "As noted above, set-up tokens are generated during stage 1 pre-processing."*);

c. a normal polygon processing section for performing hidden surface removal processing by Z-buffer method on the normal polygons (*lines 17-20 of column 15: " The hidden surface removal module 705 utilizes a Z-Buffer algorithm to eliminate pixels that will not be shaded, because they are "behind" other objects (i.e. not front most)."*) based on the visual-point coordinates and the depth values of the normal polygons (*lines 45-47 of column 15: "In this context, this means that a first object with a higher Z-value than a second object, will be behind and thus hidden by the second object.* ") and updating color data (*lines 23-26 of column 15: "Stage 2 also performs an ambient color calculation on the visible pixels (via RGBA module 706), and places these values into the Pixel Interpolation Token."*) and a Z value of each pixel in the pixel memory and the Z-buffer memory based (*lines 55-57 of column 15: "If the value is less than or equal to the value in the Z buffer, then the new lower Z-value is returned to the Z-buffer, step 827 and a check for the last object is made, step 828."*) on the processing result;

d. a back-facing shadow polygon processing section for obtaining a coordinate region positioned in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates and the depth values of the back-facing shadow polygons (*line 65 of column 21 through line 2 of column 22: "If a shadow polygon in front of the pixel faces the front of the scene the shadow count is decremented by one. If a shadow polygon in front of the pixel faces the rear of the scene, the shadow count is incremented."*) and on the Z values (*lines 59-61 of column 21: "During this*

second pass the closest Z-values are read from the buffer and compared with incoming shadow polygons for each light source.") after the hidden surface removal processing is performed (*lines 51-53 of column 21: "In a first pass, a z-buffer calculation is performed to identify the front most object at every pixel."*);

e. a shadow flag memory for storing a flag value representing a visual-point coordinate positioned in front of the back-facing shadow polygons (*lines 47-50 of column 21: " Using these dummy polygons, the processing unit then determines whether each pixel on a visible object is inside one of the shadow volumes. "; lines 4-7 of column 22: "If, the shadow count is lower than it began after all the shadow polygons have been processed; the pixel is in shadow with respect to that polygon. "*); and

f. a front-facing shadow polygon processing section for obtaining a coordinate region positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point (*lines 54-59 of column 21; lines 2-7 of column 22: "A volume entirely in front of the pixel will generate one increment and one decrement at that pixel, leaving the shadow count unchanged. If, the shadow count is lower than it began after all the shadow polygons have been processed; the pixel is in shadow with respect to that polygon."*) based on the visual-point coordinates and the depth values of the front-facing shadow polygons and on the Z values (*lines 59-61 of column 21*) after the hidden surface removal processing is performed and on the flag value (*lines 51-53 of column 21*), and

g. for updating color data on pixels in the pixel memory corresponding to the obtained coordinate region to shadow color data (*Figure 8b-1 shows updating color 833*

after shadow testing 829-832 on a region in processing "Stage 2", and Figure 8c shows the pixel color values loaded in a scanline buffer 846 subsequently in Stage 3)."

10. With regard to the limitation of claim 4 recited on lines 14-15 on page 50, "converting the graphic data to visual-point coordinates and depth values," one of ordinary skill in the art would recognize that the shadow polygon is associated with the depth values calculated in stage 1 through the Z setup token, shown in "CHART C" in column 24, from the statement on lines 61-64 of column 21, and the shadow polygons are processed in "Stage One" from lines 18-19 of column 24.

11. With regard to the limitation of claim 4 recited on lines 10-12 on page 51, "a shadow flag memory for storing a flag value representing a visual-point coordinate positioned in front of the back-facing shadow polygons," one of ordinary skill in the art would recognize that Kelley et al discloses a "shadow count" analogous to a "a shadow flag" recited in claim 4 from the statement in lines 4-7 of column 22: "If, the shadow count is lower than it began after all the shadow polygons have been processed; the pixel is in shadow with respect to that polygon." Although Kelley et al teaches a "shadow count" to "determine if the visual-point coordinate is positioned in front of the back-facing shadow polygons", Kelley et al is silent on storing the shadow count in memory. However, this feature is deemed to be inherent to the system as line 65 of column 21 through line 2 of column 22 show operations being performed on a retained value. The Kelley et al system would be inoperative if the shadow count value were not stored in memory.

12. With regard to claim 6, Kelley et al discloses "if a plurality of the shadow volumes are present, the back-facing shadow polygon processing section and the front-facing shadow polygon processing section perform processing concerning the shadow polygons per shadow

volume" (*lines 54-57 of column 21: "In a second optional pass, the determination of which of the identified visible pixels are inside a shadow volume is done by examining the shadow volumes in front of each pixel."*). One of ordinary skill in the art would recognize front facing and back facing shadow polygon processing is completed for each shadow volume from the statements in line 65 of column 21 through line 2 of column 22 (*"If a shadow polygon in front of the pixel faces the front of the scene the shadow count is decremented by one. If a shadow polygon in front of the pixel faces the rear of the scene, the shadow count is incremented"*), showing that both front facing and back facing polygon processing is performed per shadow volume. Furthermore, Kelley et al teaches processing not complete until all shadow volume polygons have been processed as indicated by statement on lines 4-8 of column 22.

13. With regard to claim 9, Kelley et al discloses "a graphic processing method using a Z-buffer memory storing a Z value representing a depth of a display object when seen from a visual point per pixel and a pixel memory storing color data on each pixel for creating an image of a shadowed three-dimensional object having shadows produced by obstructing a ray of light from a light source by the three-dimensional object, comprising:

h. converting graphic data on normal polygons constituting each object including the three-dimensional object to visual-point coordinates and depth values (*lines 37-40 of column 14, previously cited in the rejection of claim 4*);

i. converting graphic data on shadow polygons constituting a shadow volume that defines a shadow space produced by obstructing the lay of light from the light source by the three-dimensional object (*lines 39-45 of column 21, previously cited in the rejection of claim 4*) to visual-point coordinates and depth values (*lines 45-47 of column 14,*

previously cited in the rejection of claim 4), and sorting the visual-point coordinates and the depth values into those of front-facing shadow polygons that face front when seen from the visual point and those of back-facing shadow polygons that face back when seen from the visual point (*lines 61-64 of column 21, previously cited in the rejection of claim 4; lines 18-19 of column 24, previously cited in the rejection of claim 4*);

j. performing hidden surface removal processing by Z-buffer method on the normal polygons based on the visual-point coordinates and the depth values of the normal polygons (*lines 17-20 of column 15, previously cited in the rejection of claim 4*) and updating color data and a Z value of each pixel in the pixel memory and the Z-buffer memory based on the processing result (*lines 23-26 of column 15, previously cited in the rejection of claim 4)*;

k. obtaining a coordinate region positioned in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates and the depth values of the back-facing shadow polygons and the Z values after the hidden surface removal processing is performed (*line 65 of column 21 through line 2 of column 22, previously cited in the rejection of claim 4; lines 51-53 of column 21, previously cited in the rejection of claim 4*);

l. obtaining a coordinate region positioned behind the front-facing shadow polygons when seen from the visual point (*lines 54-59 of column 21, previously cited in the rejection of claim 4)* based on the visual-point coordinates and the depth values of the front-facing shadow polygons (*lines 59-61 of column 21, previously cited in the rejection*

of claim 4) and the Z values after the hidden surface removal processing is performed (*lines 51-53 of column 21, previously cited in the rejection of claim 4*);

m. and updating color data on pixels in the pixel memory corresponding to a coordinate region positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point to shadow color data (*Figure 8b-1 shows updating color 833 after shadow testing 829-832 on a region in processing "Stage 2", and Figure 8c shows the pixel color values loaded in a scanline buffer 846 in a subsequent processing "Stage 3"*)."

14. With regard to claim 10, Kelley et al discloses the limitations recited in claim 4. Claim 10 is rejected as being similar in scope to claim 4.

15. With regard to claim 11, Kelley et al shows the limitations of claim 10. Furthermore, Kelley et al discloses a "a program storage medium allowing computer to read" (*lines 48-61 of column 7: "...a random access memory (RAM) or other storage device 403 (commonly referred to as a main memory) coupled with said bus 401 for storing information and instructions for said processor 40, a read only memory (ROM) or other static storage device 404 coupled with said bus 401 for storing static information and instructions for said processor 402, a data storage device 405, such as a magnetic disk and disk drive, coupled with said bus 401 for storing information and instructions..."*).

Claim Rejections - 35 USC § 103

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

18. Claims 1 and 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,897,865 to Higashiyama (herein referred to as "Higashiyama") in view of U.S. Patent No. 5,043,922 to Matsumoto (herein referred to as "Matsumoto").

19. Higashiyama discloses "a graphic processing apparatus (*1 in Fig. 1*) having a Z-buffer memory (*8b in Fig. 2*) storing a Z value representing a depth of a display object when seen from a visual point per pixel (*lines 31-37 of column 4; lines 5-12 of column 4: "...to Z-values to be stored in a Z-value memory 8b..."*) and a pixel memory storing color data on each pixel for creating an image (*lines 12-13 of column 5: "The image writing section 122 writes color data of the respective pixels of this image in the frame buffer 8a..."*) of a shadowed three-dimensional object having a shadow produced by obstructing a ray of light from a light source by the three-dimensional object (*lines 35-37 of column 5: "...the color data of the shadow model is added to the frame color data of this pixel if the former is smaller than the latter (Step ST7)."*), comprising:

n. a visual-point coordinate conversion processing section for upon input of graphic data on normal polygons constituting each object including the three-dimensional object

and on shadow polygons constituting a shadow volume that defines a shadow space produced by obstructing the ray of light from the light source by the three-dimensional object (*lines 13-17 of column 4: "Here, a shadow model (shadow volume) is a polygon model expressing an area which is so set in the simulated 3D space as to correspond to a position and a size of a mountain, building or the like for which a shadow is to be created and a propagating direction of rays from a light source, etc."*), converting the graphic data to visual-point coordinates and depth values (*lines 31-37 of column 4: "The image writing section...writes Z-values, i.e. distances to the polygons corresponding to the respective pixels from the viewpoint of the virtual camera in the simulated 3D space, in the Z-value memory 8b."*), and

o. outputting the obtained visual-point coordinates and depth values in a state of being sorted into those of front-facing shadow polygons that face front, those of back-facing shadow polygons that face back when seen from the visual point, and those of the normal polygons (*line 67 of column 3 through line 5 of column 4: "The signal processor 11 includes a polygon sorting section 111 for sorting polygons forming a shadow model into front-facing polygons facing in directions toward a viewpoint of a virtual camera and back-facing polygons facing in directions opposite from the viewpoint of the virtual camera."*); and

p. shadowing processing section for obtaining a coordinate region that is positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates, the depth values and the Z-buffer memory (*lines 19-28 of column 6: "As shown in FIG. 4,*

shadow pixels, i.e. those of which form shadow image K are pixels corresponding to the front-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels, while excluding pixels corresponding to the back-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels."), and

q. updating color data on pixels in the pixel memory corresponding to the obtained coordinate region to shadow color data" (*lines 38-42 of column 44: " The shadow creating section 123 creates a shadow image of the 3D model by subtracting the color data of the shadow model from the frame color data of the pixel stored in the frame buffer 8a for the pixels (shadow creating pixels) which are pixels corresponding to the front-facing polygons of the shadow model... "*).

20. With respect to the limitation of claim 1 recited on lines 20 and 21 on page 48, Higashiyama does not use the explicit language sorting normal polygons; however, one of ordinary skill in the art would recognize this feature is inherent from the statement on lines 26-29 of column 4: "The model image creating section 121 applies texture mapping and rendering to all the models except the shadow model located in the simulated 3D space to form an image of all the models except the shadow model."

21. Higashiyama does not expressly disclose "a hidden surface removal" or "hidden surface removal processing by Z-buffer method is performed on the normal polygons." Matsumoto discloses "hidden surface removal processing by Z-buffer method is performed on the normal

polygons" (*lines 64-67 of column 8: "The hidden-surface removal section 9 interpolates the depth data z of each pixel position on the appropriate span data, and compares it to the depth data z' in a Z-buffer 11 (FIG. 9(a)).*"). In addition, Matsumoto discloses that the shading (*16 in Figure 1*) by shadow volume (*Figure 2a*) is performed after hidden-surface removal (*9 in Figure 1*).

22. Higashiyama and Matsumoto are analogous art because they are from a similar problem solving area: shadow generation for computer graphics. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply hidden surface removal using the depth buffer before shading as disclosed by Higashiyama in the system disclosed by Matsumoto. The motivation for doing so would have been to avoid unnecessary and erroneous calculations on surfaces that do not contribute intensity information to pixel values the final rendering. Therefore, it would have been obvious to combine Higashiyama with Matsumoto to obtain the invention specified in claim 1.

23. With regard to claim 3, Matsumoto further discloses "if a plurality of the shadow volumes are present, the hidden surface removal and shadowing processing section performs processing concerning the shadow polygons per shadow volume" (*lines 21-26 of column 9: "After completion of the processing of the hidden-surface removal...the shadow polygons are processed. The span data of each shadow polygon is sequentially supplied to a pseudo hidden-surface removal section 13."*; *lines 55-56 of column 8: "2) Then, to process span data of the shadow polygons for each shadow volume."*; *Figure 25 shows multiple shadow volumes*).

24. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to further modify the combination of Higashiyama and Matsumoto to include the

capability to process a plurality of shadow volumes as further taught by Matsumoto. Higashiyama suggests incorporating such a capability in lines 37-41 of column 6 and provides the motivation in lines 43-44 of column 6: "The more the shadow models, the more realistic an image can be made." Therefore, it would have been obvious to further modify the combination of Higashiyama and Matsumoto to obtain the invention specified in claim 3.

25. **Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kelley et al.**

26. With regard to claim 5, Kelley et al discloses "the Z-buffer memory, the pixel memory, and the shadow flag memory have a capacity for one line in one display screen (*lines 24-26 of column 32: "FIG. 12 is a functional block diagram of a stage 2/3 processing unit. A RAM 1201 and a RAM 1202 comprise the dual buffers and consist of one scanline of memory each."; lines 63-66 of column 31: "When performing scanline Z-buffering or operating as a compositing engine, both require at least one complete scanline of memory."*), and the normal polygon conversion section, the shadow polygon conversion section, the normal polygon processing section, the back-facing shadow polygon processing section, and the front-facing shadow polygon processing section process per line."

27. One of ordinary skill in the art would recognize that the processing is done per line from the statements on lines 66-67 of column 3 (*"In the scanline approach the 3-D image is rendered a scanline at a time, rather than an object at a time."*) and lines 10-13 of column 6 (*"Utilizing a scanline approach for rendering a 3-D graphical image, alternative rendering device configurations provide scalable rendering performance."*).

28. Kelley et al discloses shadow flag memory, but does not explicitly disclose "<u>one line</u> of shadow flag memory." One of ordinary skill in the art would recognize the system operates by

performing the operations one scanline at a time, and computes a shadow count for each pixel in each scanline from the statement lines 1-4 of column 22: "A volume entirely in front of the pixel will generate one increment and one decrement <u>at that pixel</u>, leaving the shadow count unchanged."

29. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to store the shadow flags in one line of shadow flag memory in the system disclosed by Kelley et al. The motivation for doing so would have been to provide the system with the flexibility to process the pixels out of order or in parallel. For example, as each shadow polygon is processed a scanline of shadows count values can be updated and retained in memory, which is clearly more advantageous than updating and retaining one shadow count. Kelley et al discloses the advantages of scanline independence for "Parallel Rendering Pipelines" in lines 5-20 of column 37. Therefore, it would have been obvious to modify Kelley et al to obtain the invention specified in claim 5.

30. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Higashiyama in view of Matsumoto and in further view of Kelley et al.

31. With regard to claim 2, the combination of Higashiyama and Matsumoto show the limiations of parent claim 1. Furthermore, Higashiyama discloses "the Z-buffer memory and the pixel memory have a capacity for one line in one display screen" (*lines 58-63 of column 4: "The frame buffer 8a is adapted to store the frame color data which are color data of each pixel of the image obtained by applying rendering, and a Z-value memory 8b is adapted to store distances Z between the viewpoint of the virtual camera and the polygons corresponding to the respective pixels in the simulated 3D space."*). One of ordinary skill in the art would recognize that the

system disclosed by Higashiyama would be inoperative if it did not have "a capacity for one line in one display screen," as the "color data of each pixel of the image" is stored. Therefore, this feature is deemed to be inherent to the frame buffer and z-value memory recited by Higashiyama in lines 58-63 of column 4. However Higashiyama and Matsumoto do disclose "the visual-point coordinate conversion processing section and the hidden surface removal and shadowing processing section process per line." Kelley et al teaches this limitation as shown in the rejection of claim 6, the rejection herein incorporated by reference.

32. Higashiyama, Matsumoto and Kelley et al are analogous art because they are from a similar problem solving area: shadow generation for computer graphics. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate hidden surface removal and shadowing processing per scanline, as taught by Kelley et al, in the system disclosed by the combination of Higashiyama and Matsumoto. The motivation for doing so is given by Kelley et al in lines 13-15 of column 37: "*As described above this scanline independence also has residual effects in terms of reducing bandwidth requirements and storage requirements.*" Therefore, it would have been obvious to further modify the combination of Higashiyama and Matsumoto with Kelley et al to obtain the invention specified in claim 2.

33. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kelley et al in view of U.S. Patent No. 6,402,615 to Takeuchi (herein referred to as "Takeuchi").

34. With regard to claim 7, Kelley et al shows the limitations of parent claim 4, but does not show "a portable device." Takeuchi discloses a graphics system on "a portable device" (*lines 23-*

25 of column 22: "Further, it may also be realized using a mobile phone, portable data terminal, car navigation system, or other communications terminal as a platform.").

35. With regard to claim 8, Kelley et al shows the limitations of claim 4 on which claim 8 depends, but does not show "a communication network." Takeuchi discloses "the portable device is connectable to a communication network, and the graphic data is obtained through communications via the communication network" (*lines 14-17 of column 5: "Specifically, for example, it is also possible to use the communications interface unit 109 to download the game program from another piece of equipment, not shown, on the network connected through the communications line 111"*).

36. Kelley et al and Takeuchi are analogous art because they are from the same field of endeavor: computer graphics. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate the graphics system disclosed by Kelley et al on a mobile device that receives graphical data over a network as taught by Takeuchi. The motivation for doing so would have been to provide the user with the flexibility to view the graphical data at convenient location while not overburdening the portable device with the storage requirement of the graphical data. Therefore, it would have been obvious to combine Kelley et al with Takeuchi to obtain the invention specified in claims 7 and 8.

Conclusion

37. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M. Repko whose telephone number is 571-272-8624. The examiner can normally be reached on Monday through Friday 8:30 am -5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on 571-272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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